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HOST SELECTION IN XYLOPHILIC CECIDOMYIIDAE (DIPTERA): VESSEL SIZE AND STRUCTURE

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Abstract.—Larvae of xylophilic Cecidomyiidae develop only in woody angiosperms with vessels of 75 μ or greater diameter. Because vessel diameter varies with trunk or branch diameter, mature parts of some species of hardwoods may offer suitable niches for larval development while smaller branches or twigs may not. Vessel diameters of the herbaceous angiosperms tested were less than 75 μ and gymnosperms lack vessels; hence neither are hosts.

Xylophilic Cecidomyiidae are an unusual guild of gall midges that use freshly exposed xylem vessels of hardwoods as a larval niche. The biology of two European species was described in detail by Kieffer (1900). We reported on the biology of several nearctic species that live in the vessels of hardwoods in Ohio (Rock and Jackson, 1985). All known species have similar multivoltine life cycles. Females oviposit in sapwood vessels of freshly cut hardwoods where larval development is completed in approximately two weeks. Mature larvae emerge from the vessels when rainfall is sufficient to soak the wood. Pupation occurs in soil and summer generations of adults emerge 10–16 days later.

Host plant suitability probably depends on several factors including: olfactory attraction to exposed wood, suitable vessel diameter for oviposition, vessel diameter adequate for larval development, and available nutrients. This paper examines the significance of vessel diameter on host tree suitability. Data is reported for the following species: *Xylodiplosis longistylus* Gagné; *Trogodiplosis flexuosa* Gagné; *Ledomyia emilyae* Gagné; *Ledomyia mira* Gagné; and *Ledomyia parva* Gagné. Unless otherwise indicated, *X. longistylus* was used for laboratory studies because of its ready availability.

METHODS AND MATERIALS

We have previously described methods for collecting and rearing the adults and larvae (Rock and Jackson, 1985). Freshly cut samples of 17 species of hardwoods and one species of softwood were collected for this study and placed at field sites where natural populations of the midges occurred (Table 1). Stems from some of the herbaceous angiosperms found at or near the field sites were also examined (Table 1).

Quercus and *Fraxinus* have been described as suitable hosts (Kieffer, 1900, 1904; Huggert, 1980; Rock and Jackson, 1985) and we initially used them as

Table 1. Hardwood and herbaceous angiosperms and gymnosperms tested.

	Diameter of Largest Sample (cm)*	Larvae Collected	Maximum Vessel Diameter (μ) in Logs 8 cm d.**
Angiosperms			
Acer saccharinum Marsh	35	–	50
Betula papyrifera Marsh	9	–	50
Carpinus caroliniana Walt.	9	+	75
Carya ovata (Mill.) K. Koch	26	+	250
Crataegus sp.	8	–	35
Fraxinus americana	25	+	200
Juglans nigra L.	25	+	250
Malus sp.	16	–	50
Morus nigra L.	25	+	240
Populus deltoides Bartr.	12	+	75
Prunus serotina Ehrh.	31	–	62
Prunus sp.	25	–	50
Quercus alba L.	31	+	250
Robinia pseudoacacia L.	21	–	250
Salix babylonica Marsh	9	+	75
Sassafras albidum (Nutt.) Nees	8	+	200
Ulmus americana L.	20	+	175
Zea mays L.	3	–	50
Helianthus annuus L.	2	–	50
Helianthus tuberosus L.	2	–	50
Cirsium arvense (L.) Scop.	1	–	50
Gymnosperms			
Pinus strobus L.	19	–	Vessels absent

* All samples 25–30 cm long.
** Stem diameter smaller in herbaceous angiosperms.

controls. The suitability of a sample of a wood for larval development was determined by exposing the wood for oviposition for a minimum of three weeks, then placing the sample in a bin of water and recording larval emergence. Larval emergence indicated a suitable host.

Vessel diameter in hardwoods decreases as branch diameter decreases (Zimmerman and Brown, 1971). Wood samples of varying diameter were cut from known host species and left at the field sites to determine which parts of the tree contained vessels suitable for larval development. Branches were selected with diameters gradually increasing from 3 mm to 50 mm. The exposed vessels at the base of leaf petioles and at fresh leaf scars were tested in the same manner. Similar samples were offered to caged females in the laboratory. Vessel diameters were measured with the aid of a stereomicroscope and an ocular micrometer.

Results and Discussion

In all wood samples tested, measured vessel diameters corresponded with the ranges reported by Panshin and Zeeuw (1970). Table 1 lists species of study plants from which larvae were or were not collected. Table 2 lists the species of xylophilic cecidomyiids associated with each host wood. All samples of host species contained some vessels with a diameter of at least 75 μ. The species of

Table 2. Host specificity of xylophilic Cecidomyiidae.

Host	*Xylodiplosis longistylus*	*Trogodiplosis flexuosa*	*Ledomyia mira*	*Ledomyia parva*	*Ledomyia emilyae*	*Ledomyia* sp. (not further identified)
Carpinus caroliniana	+	0*	0	0	0	0
Carya ovata	+	0	0	+	0	+
Fraxinus americana	+	+	0	0	0	+
Juglans nigra	+	+	0	0	0	+
Morus nigra	+	0	0	0	0	0
Populus deltoides	+	+	0	0	0	0
Quercus alba	+	+	+	+	+	+
Salix babylonica	+	0	0	0	0	0
Sassafras albidum	+	+	0	0	0	0
Ulmus americana	+	+	0	0	0	+

* 0 = not tested on this plant.

plants from which no larvae were collected are presumably unsuitable as hosts. With the exception of *Robinia pseudoacacia,* the largest available vessels in non-host species were 62 μ d., with most species having a maximum vessel d. of 50 μ or less.

Although we have limited data from field observations, it appears that non-host species probably do not attract females or do not trigger oviposition. No females were observed visiting field samples of non-host plants, nor were females from caged populations of *Trogodiplosis* and *Xylodiplosis* attracted to *Robinia* or *Crataegus* samples. Caged females of *Ledomyia* sp. and *Xylodiplosis* were observed feeding in the sapwood areas of *Prunus serotina* and *Malus* sp. without attempting to oviposit. However, it is possible that some of the hardwoods that appear to be unsuitable for larval development may attract female gall midges and trigger oviposition, but a vessel large enough to allow ovipositor insertion may not be adequate for completion of larval development. Nevertheless, our data indicate that a vessel of at least 75 μ d. is needed for larval development and that vessel diameter is significant in determining host suitability.

Table 1 lists the herbaceous angiosperms we tested as potential hosts. The vessels of all these species were less than 50 μ d. Female gall midges were never observed attempting to oviposit on the broken stems nor were larvae ever collected from the samples. Gymnosperms lack vessels and do not provide a suitable larval habitat: no larvae were collected from field site samples of *Pinus strobus* L. These data suggest that the host plants of xylophilic gall midges are confined to some of the hardwood angiosperms.

Although the foregoing discussion of hardwood vessels and host suitability has referred to branches of substantial diameter (see Table 2) some small twigs and branches are also used by the gall midges. Vessels are elongated cones. Therefore, in a given species of tree vessels in old wood may be of suitable diameter, while those in new twigs are not. In most host tree species, twigs of 6 mm d. have some vessels 75 μ d. or greater and are suitable for larval development (Table 3). Vessels in narrower twigs, in leaf petioles, and in leaf scars are usually too small for oviposition. Observations of caged females have shown that vessels of approximately 25 μ are too small to allow ovipositor insertion. However, females are

Table 3. Maximum vessel diameter in small branches and leaf scars of some hardwood hosts.

Host	Branch Diameter (mm)	Maximum Vessel Diameter: Branch (μ)	Maximum Vessel Diameter: Scars (μ)
Carya	5.5	75	<25
	6.5	87	<25
Carpinus	4.5	25	<25
	7	25	<25
Fraxinus	5	75	<25
	6.5	75	<25
Juglans	5	62	<25
	6	75	<25
Quercus	5	62	<25
	6	75	<25
Salix	20	50	<25
Sassafras	5	62	<25
	6	75	<25

attracted to leaf scars of a host twig for a few days after the leaves are removed. This may aid in attracting females into the vicinity of a host tree and enhance the possibility of encountering a broken branch.

Literature Cited

Huggert, L. 1980. Taxonomical studies on some genera and species of Platygastrinae (Hymenoptera: Proctotrupoidea). Entomol. Scand. 11: 97–112.

Kieffer, J. J. 1900. Monographie des Cecidomyies d'Europe et d'Algérie. Ann. Soc. Entomol. Fr. 69: 341–343.

———. 1904. Nouvelles cecidomyies xylophiles. Ann. Soc. Sci. Brux. 28: 367–410.

Panshin, A. J. and Carl de Zeeuw. 1970. Textbook of wood technology. Vol. 1. 3rd ed. McGraw-Hill Book Co., New York. 705 pp.

Rock, Emily A. and Dale Jackson. 1985. The biology of xylophilic Cecidomyiidae (Diptera). Proc. Entomol. Soc. Wash. 87: 135–141.

Zimmerman, Martin H. and Claud L. Brown. 1971. Trees: Structure and function. Springer-Verlag, New York. 336 pp.